

WHAT IS CLAIMED IS:

1 1. An apparatus comprising:
2 a processing chamber configured to carry out chemical vapor deposition
3 (CVD), the chamber including a platform configured to receive a wafer;
4 an ampoule vaporizer fastened to the chamber, configured to convert a
5 fluorine-free tungsten-containing solid compound to vapor; and
6 a funnel-shaped dispersion plate configured to receive a gas mixture including
7 the vapor and direct the gas mixture toward a surface of the wafer in a substantially uniform
8 manner.

1 2. The apparatus of claim 1 further comprising a mass flow controller
2 fastened to the chamber, configured to receive the vapor from the ampoule vaporizer and
3 regulate the flow of the vapor.

1 3. The apparatus of claim 2 further comprising a mixing fixture
2 configured to receive the vapor from the mass flow controller, mix the vapor with one or
3 more other gas(es) to form the gas mixture, and deliver the gas mixture to the dispersion
4 plate.

1 4. The apparatus of claim 1 wherein the solid compound is tungsten
2 hexacarbonyl ($W(CO)_6$).

1 5. The apparatus of claim 2 wherein the ampoule vaporizer and the mass
2 flow controller are fastened to a top lid of the chamber.

1 6. The apparatus of claim 1 wherein the chamber further includes a face
2 plate between the dispersion plate and the wafer, the face plate having a plurality of passages
3 extending from a top surface to a bottom surface of the plate, and being configured to present
4 a suitably uniform thermal profile to the wafer so that the wafer may be uniformly heated.

1 7. The apparatus of claim 1 wherein the dispersion plate comprises:
2 a body having a center axis, an input face, an output face, and a thickness
3 between the faces; and

an input opening along the center axis in the input face for receiving a stream of vapor, the input opening extending radially from the center axis to an output opening in the output face through which the stream of vapor exits.

8. The apparatus of claim 7 wherein the input opening extends along the center axis to form a hole before extending radially to the output opening, the hole having a substantially hour-glass shape.

9. The apparatus of claim 8 wherein the hole extends radially from the center axis to the output opening forming an angle having a value at the output opening in the range of 60-85 degrees.

10. An apparatus comprising:
a processing chamber configured to carry out chemical vapor deposition (CVD); and
an ampoule vaporizer fastened to the chamber, configured to convert a fluorine-free tungsten-containing solid compound to vapor delivered to the chamber for use in the CVD.

11. The apparatus of claim 10 further comprising:
a mass flow controller fastened to the chamber, configured to receive the vapor from the ampoule vaporizer and regulate the flow of the vapor.

12. The apparatus of claim 10 wherein the solid compound is tungsten hexacarbonyl ($W(CO)_6$).

13. The apparatus of claim 11 wherein the ampoule vaporizer and the mass flow controller are fastened to a top lid of the chamber.

14. The apparatus of claim 11 further comprising a mixing fixture configured to receive the vapor from the mass flow controller, mix the vapor with one or more other gas(es), and deliver the resulting gas mixture to the chamber interior.

15. The apparatus of claim 14 wherein the chamber comprises:
a platform configured to receive a wafer; and

3 a funnel-shaped dispersion plate configured to receive the gas mixture from
4 the mixing fixture and direct the gas mixture toward a surface of the wafer in a substantially
5 uniform manner.

1 16. The apparatus of claim 15 wherein the dispersion plate comprises:
2 a body having a center axis, an input face, an output face, and a thickness
3 between the faces;
4 an input opening along the center axis in the input face for receiving a stream
5 of vapor, the input opening extending radially from the center axis to an output opening in
6 the output face through which the stream of vapor exits.

1 17. The apparatus of claim 16 wherein the input opening extends along the
2 center axis to form a hole before extending radially to the output opening, the hole having a
3 substantially hour-glass shape.

1 18. The apparatus of claim 17 wherein the hole extends radially from the
2 center axis to the output opening forming an angle having a value at the output opening in the
3 range of 60-85 degrees.

1 19. The apparatus of claim 15 wherein the chamber further includes a face
2 plate between the dispersion plate and the wafer, the face plate having a plurality of passages
3 extending from a top surface to a bottom surface of the plate, and being configured to present
4 a suitably uniform thermal profile to the wafer so that the wafer may be uniformly heated.

1 20. A chemical vapor deposition method for forming a layer of tungsten on
2 a wafer, the method comprising:
3 placing a wafer in a processing chamber;
4 converting a fluorine-free tungsten-containing solid compound to vapor using
5 an ampoule vaporizer fastened to the chamber;
6 delivering the vapor to a mixing fixture configured to mix the vapor with one
7 or more other gas(es); and
8 introducing the gas mixture into the processing chamber for forming the layer
9 of tungsten.

1 21. The method of claim 20 wherein the solid compound is tungsten
2 hexacarbonyl ($W(CO)_6$).

1 22. The method of claim 20 further comprising:
2 delivering the vapor from the ampoule vaporizer to the mixing fixture through
3 a mass flow controller fastened to the chamber, the mass flow controller regulating the flow
4 of the vapor.

1 23. The method of claim 22 wherein the ampoule vaporizer and the mass
2 flow controller are fastened to a top lid of the chamber.

1 24. The method of claim 22 further comprising:
2 directing the gas mixture provided by the mixing fixture toward a surface of
3 the wafer in a uniform manner using a funnel-shaped dispersion plate.

1 25. The method of claim 24 wherein the dispersion plate includes a body
2 having a center axis, an input face, an output face, a thickness between the faces, and an input
3 opening along the center axis in the input face for receiving a stream of vapor, the input
4 opening extending radially from the center axis to an output opening in the output face
5 through which the stream of vapor exits.

1 26. The method of claim 25 wherein the input opening extends along the
2 center axis to form a hole before extending radially to the output opening, the hole having a
3 substantially hour-glass shape.

1 27. The method of claim 26 wherein the hole extends radially from the
2 center axis to the output opening forming an angle having a value at the output opening in the
3 range of 70-85 degrees.

1 28. The method of claim 24 further comprising:
2 directing the gas mixture through a face plate positioned between the
3 dispersion plate and the wafer, the face plate having a plurality of passages extending from a
4 top surface to a bottom surface of the plate, and being configured to present a suitably
5 uniform thermal profile to the wafer so that the wafer may be uniformly heated.

1 29. A processing chamber configured to carry out chemical vapor
2 deposition (CVD), comprising:
3 a platform configured to receive a wafer; and

4 a funnel-shaped dispersion plate configured to receive a gas mixture and direct
5 the gas mixture toward a surface of the wafer in a substantially uniform manner.

1 30. The chamber of claim 29 further comprising a mixing fixture
2 configured to receive a fluorine-free tungsten-containing precursor and one or more carrier
3 gas(es) to form the gas mixture, and deliver the gas mixture to the dispersion plate.

1 31. The chamber of claim 29 wherein the fluorine-free tungsten-containing
2 precursor is tungsten hexacarbonyl ($W(CO)_6$) vapor.

1 32. The chamber of claim 29 wherein the dispersion plate comprises:
2 a body having a center axis, an input face, an output face, and a thickness

3 between the faces;

4 an input opening along the center axis in the input face for receiving the gas
5 mixture, the input opening extending radially from the center axis to an output opening in the
6 output face through which the gas mixture exits.

1 33. The chamber of claim 32 wherein the input opening extends along the
2 center axis to form a hole before extending radially to the output opening, the hole having a
3 substantially hour-glass shape.

1 34. The chamber of claim 33 wherein the hole extends radially from the
2 center axis to the output opening forming an angle having a value at the output opening in the
3 range of 60-85 degrees.

1 35. The chamber of claim 30 further comprising a face plate between the
2 dispersion plate and the wafer, the face plate having a plurality of passages extending from a
3 top surface to a bottom surface of the plate, and being configured to present a suitably
4 uniform thermal profile to the wafer so that the wafer may be uniformly heated.